Crime Scene Investigation at Radioactive Contaminated Sites

Izabella Kakuja[1]

Environmental safety, as an integral part of security, is negatively affected by the uncontrolled use of radioactive/nuclear materials and by criminal acts committed with/on such materials. Working at the scene of such crimes requires a high level of expertise and extreme attention. The presence of radioactive materials at crime scenes is no longer a curiosity[2]. These may include explosive devices capable of dispersing radioactive/nuclear materials or materials used for poisoning/radiation. Their accurate identification, collection and professional examination require specialised expertise and a high level of training. If the radioactive/nuclear material is not identified by specialist personnel during the on-site activity, bystanders may suffer health hazards and/or contaminate large areas and objects, thus adding to the underlying problem. Recognition alone is not enough, you need to know how to create and maintain a safe working environment. However, it must be recognised that this is not always feasible, i.e. crime scene investigation work processes and, where appropriate, forensic investigations must be carried out in an environment contaminated with radioactive material. The first step is to identify the hazards on site and, in the light of this, to select the appropriate personal protective equipment (PPE), as the presence of radioactive/nuclear materials on the site poses a particular safety risk. The focus should then shift to the professional and lawful collection of criminal evidence, including radiological material, conventional evidence contaminated with radiological material and conventional uncontaminated evidence. In my paper, I will describe this process from detection, through preparation, to the completion of the on-site inspection.

Keywords: contaminated crime scene, evidence, crime scene investigation.

I. Introduction

In order to demonstrate the procedure, it is necessary to understand the concept. In general, the concept created by the UN International Atomic Energy Agency is internationally accepted. "Radiological Crime Scene Management (RCSM) is the process used to ensure safe, secure, effective, and efficient operations at a scene where nuclear or other radioactive materials are known to be or are suspected of being present."[3]

Today, it is not so unusual to find radiological material at the scene of a crime. However, to deal with this type of site requires special expertise and special measuring instruments. Both are needed in combination. As I mentioned earlier, without special expertise, detection can fail and those on the scene and in the surrounding area can suffer health damage and/or contaminate large areas and objects. The question arises as to whether it is sufficient for the forensic scientists to carry out the on-site investigation with radiological advice. The answer is no. This is partly because conventional crime scene investigators are not trained to detect radiological materials. Partly because they do not have the equipment to detect radiation. Without detection, radiation is undetectable because it has no smell, no taste, no visibility, no special appearance.

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[2]Izabella, Kakuja: Data extraction during CBRN Crime Scene Investigation, Safety and Security Sciences Review, Vol 6, No 1, 2024. pp 79

[3] IAEA Nuclear Security Series No. 22–G, Radiological Crime Scene Management, Implementing Guide, International Atomic Energy Agency Vienna, 2014, pp.1

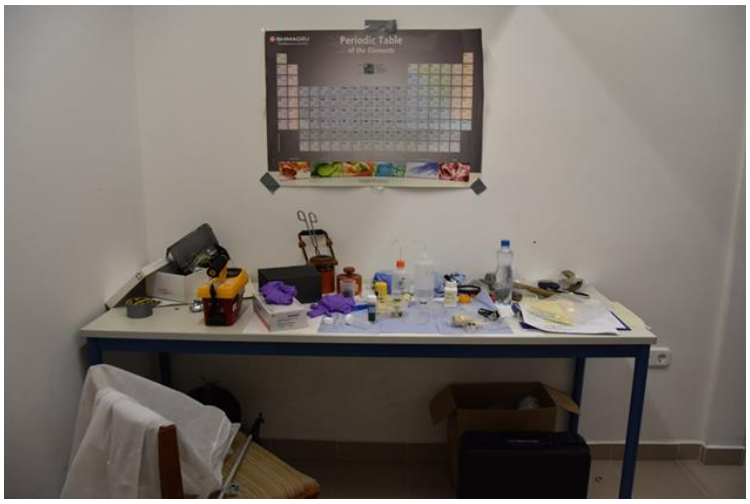
In other words, there is nothing to conclude that we are dealing with such a substance. In addition, the danger is that while the effects of biological or chemical substances are immediate, the effects of radioactive/nuclear substances can take several years, depending on the level of exposure. However, the mere recognition of the presence of radioactive materials at the scene is not enough. It requires accurate identification, collection, professional transport, handling, testing, all of which require special expertise. At this stage we are only talking about the handling of radioactive material, which does not include traditional crime scene management. At this point, we have to distinguish between crime scenes: 1. the radioactive material is the crime scene itself; 2. the conventional crime scene is contaminated with radioactive material; 3. the crime scene is not contaminated at all. Depending on which category they fall into, special rules apply to them in addition to the general rules. It is therefore necessary to take into account and manage these new risks and to consider whether new working methods should be developed in crime scene investigation.

II. Preliminary phase

A Recognition

We need to use the term 'Radiological Crime Scene Management (RCSM)' which is "the process used to ensure safe, secure, effective and efficient operations at a site where the presence of nuclear or other radioactive materials is known or suspected."[4]
It is important to note that not every incident involving radioactive material is a crime, however there are cases when the incident is classified as a crime later, after the event. That is why it is advisable to collect the evidence in such locations in accordance with the rules of forensic science and criminal procedural law. The presence of special devices, lead cases, and containers indicate that there may be radioactive/nuclear material in the area. It is important that even without these signs there may be radioactive/nuclear material on the scene, and the investigators can be informed about this in advance based on covert intelligence reports.
We have to make a difference between the presence and the hypothetical (suspected) presence of radioavtive materials. Let us take a look at the picture below to see what signs of radiation we can find.

Picture 1: Presence or suspected presence of radioactive materials[5]



[4] IAEA Nuclear Security Series No. 22–G, Radiological Crime Scene Management, Implementing Guide, International Atomic Energy Agency Vienna, 2014, pp.1,
[5] Photo credit by the author

As we can see in the picture above, there are numerous objects whose presence indicate the presence of radiant material. See the images below for details.

Pictures 2-7: Suspicious equipments and objects[6]

Without wishing to be exhaustive, the presence of these objects at the site clearly indicates that they were working with radioactive material.

III. Common and different elements between traditional CSI and radiological CSI

A Common elements

Preserving public health & safety enjoys priority over the needs of any criminal investigation. The next element is to control the persons who can enter and exit the site (to document the entries and exits by name, date, time and purpose). This is followed by the development of a common threat risk assessment and site security plan prior to the entry for evidence collection. Documenting the scene is possible by taking photograps or video recordings, making drawings or sketches. It is neccessesary to establish and maintain "chain-of-custody" for each item of evidence that is collected.

B Different elements

Radiological crime scenes differ from the conventional standards prescribing the **requirements to protect personnel at the scene from radiation hazards.** There are specific issues following principles of **Radiation Protection** which must be considered and planned for when managing the crime scene, including:

- **TIME** spent in the hazard control area;
- **DISTANCE** between the evidence contaminated with radionuclides and the individual collecting the evidence;
- Radiation **SHIELDING** between the evidence and the individual collecting the evidence;
- Radionuclide **CONTAMINATION** control;
- Individual radiation **EXPOSURE** control.[7]

[6] Photo credit by the author

[7] IAEA Nuclear Security Series No. 22–G, Radiological Crime Scene Management, Implementing Guide, International Atomic Energy Agency Vienna, 2014, pp.1,

C Conventional Crime Scene Investigation

The following three elements are completely different during the conventional crime scene investigation:

- **TIME**: crime scene investigators have unlimited time at their disposal
- **DISTANCE**: crime scene investigators can get as close to the scene and its elements as they want to, in order to collect evidence.
- **SHIELDING**: crime scene investigators do not or hardly need to use any radiaton shading or protection at crime scenes.

D Radiological Crime Scene Investigation

The three elements mentioned above involve the following features during radiological crime scene investigation:

- **TIME**: crime scene investigators must spend as little time as possible on site to avoid collecting a large dose of radiatin. The time is limted. This anticipates the need for surrogate staff to be ready on the scene because of the tight time window. So we need more human resources than a typical site and all staff deployed to a radiology site need to be trained.
- **DISTANCE**: crime scene workers should stay as far away from contaminated or suspected contaminated areas as possible. The distance has to be dealt with. For example, using long tweezers or manipulators, using special tracing devices such as Forenscope.

Picture 8: Forenscope in use[8]

- **SHIELDING**: scene workers must wear shielding because of to radioactivity.

Both the potential for contamination and the dose received must be taken into account in every case. The presence of a radioactive/nuclear element on the scene makes the procedural action extremely difficult, since it is not enough to comply with legislation, professional rules and ISO standards, but all this has to be done under time pressure, in heavy protective clothing, with extra safety rules and constant communication.[9] The collection and examination of evidence in a timely manner will greatly assist in the speedy establishment of investigative hypotheses and

[8] Photo credit by Dean Calma UN IAEA

[9]Izabella, Kakuja Data extraction during CBRN crime scene investigation, Safety and Security Sciences Review, Vol 6, No 1, 2024. pp 81

the prevention of further possible crimes, as well as the identification, tracing and prosecution of the persons involved or suspected.
This is done by accurately documenting the conditions found at the scene of the crime and collecting all relevant physical evidence in such a way that it can be used in court. However, in order to gather as much evidence as possible, we need a specialist staff and, as I mentioned earlier, the protection of human life is a priority, including the life and health of the crime scene investigators. So it becomes a task to protect them from the toxic substances at the scene and to protect the scene from contamination by the staff. Below is a description of the minimum protective outfit they should wear.

IV. Personal Protective Equipment (PPE)

In the case of radioactive materials, the use of individual, special protective equipment is necessary: Tyvek clothing sealed with tape at the wrist, taped down, arm-hand-shoe protectors, gloves, breathing mask, if necessary, lead apron, electronic personal dosimeter (EPD). Such clothing is quite uncomfortable, restricts movement, vision, it fundamentally affects and makes hearing, smelling and communication difficult. In other words, it is necessary to train the crime scene technicians how to use them. It is also important to continuously monitor those working on site at the command post.
When leaving the site, people and equipment must be decontaminated (freed from radioactive substances), the removal of protective clothing has special rules. In the case of a radiological site, both scene investigators and other personnel must use a "Hazard Control Area" and decontamination stations for proper clearance (decontamination) of personnel, instruments, and evidences.

V. Key points for radiological crime scene investigation

Handling a radiological crime scene requires special equipment, expertise and skilled procedures on both sides: radiological and traditional. Radioactive/nuclear materials can be evidence (not just hazardous materials!) This requires two basic things, one is the chain of custody, the other is the nuclear forensics must start at the scene (initial identification and categorization of the material). The nuclear forensic analytical laboratory must obtain all possible information on the material collected (type and quantity of material, isotopes identified, dose, etc.).
To summarise, one of the most important parts of radiological crime scene management is the preparation, because this is a complex and difficult process. In this presentation I will not go into this because of the short time available. After the preparations, a primary survey is essential. From the radiological point of view, this includes risk assessment, planning of work procedures, zoning, measurement of the radiological background of the site and measurement of surface contamination (detection of possible spillages, contamination). It also includes the identification, marking and disposal of hot spots (e.g. shielding of radiological material, etc.). Once the hot spots have been detected, their identification is necessary, i.e. isotopic identification of the radiological material present in the hot spots using measuring instruments (measurements are also in accordance with NATO STANAG AEP 66).[10]

[10]Izabella Kakuja: Unique Hungarian method in radiological crime scene management. Military Technology Volume LVI – 2022/5,

Picture 9: Marking[11]

However, traditional crime scene investigation must not be forgotten, i.e. visual footprints must be searched for, evidence that is prone to degradation must be protected, a path of traffic must be marked out and everything must be video recorded.

Picture 8: Measuring with telepole[12]

[11]Photo credit by Dean Calma UN IAEA
[12] Photo credit by the Cenre for Energy Research

Picture 9:First survey[13]

Picture 10: Isotope identification[14]

This is followed by the professional collection of the detected materials using tweezers and manipulators. During collection, maximum compliance with safety regulations and ABV[15] protocol must be ensured, and care must be taken to avoid contamination (cross-contamination). This is important for two reasons. Firstly, the contamination should not be taken off-site, i.e. no

[13] Photo credit by the Cenre for Energy Research
[14] Photo credit by the Cenre for Energy Research
[15]Based on the 2009 Standard Guidelines of the Chemical Defence Section of the MH Armed Forces Permanent Working Committee, the abbreviation ABV is used in MH documents.

new contaminated area should be created. Secondly, do not contaminate yourself or the crime scene. In other words, always have a "clean" technician on site to provide the crime scene with a crime scene bag and/or change gloves between each sample collection. Avoiding cross-contamination is also important for the integration of evidences. Video and photographic recordings of the crime scene are taken continuously, both before and during the procedure, including the activities of the crime scene investigators. The procedure itself must also comply with Parts 1 and 2 of the EN ISO 21043 series of standards[16].[17]
However, traditional crime scene investigation must not be forgotten, i.e. visual footprints must be searched for, evidence that is prone to degradation must be protected, a traffic path must be marked and everything must be video recorded. All material exiting the scene, including collected evidence and any equipment used for searching or recording, as well as any instruments or equipment used to detect the material, must be re-measured in the clear zone and if it is necessary.

Picture11: Contamination check[18]

They must also be decontaminated (cleaned) there. After the radioactive/nuclear material has been collected, repeat measurements should be taken on the field to see if there is any contamination left behind or not. If not, the scene can be handed over to the crime scene investigators and the level of personal protective equipment can be reduced. In the event that contamination remains at the site, then site radiological crime scene managment should continue or expert-led site work should begin. The first step is to prepare a "TRIAGE" of the evidences to be collected. Here, the priority is always to collect first those that can be easily

[16]MSZ EN ISO 21043 Forensic sciences. Part 1: Terminology and definitions Part 2: Detection, documentation, collection, transport and storage of crime scenes
[17]Izabella, Kakuja Data extraction during CBRN crime scene investigation, Safety and Security Sciences Review, Vol 6, No 1, 2024. pp 82
[18] Photo credit by Dean Calma UN IAEA

destroyed and directly point to the perpetrator.[19] However, with today's technological advances, we cannot ignore the use of digital data as evidence.

VI. Conclusions

Radiological crime scene management has much in common with traditional crime scene investigation, but there are some important differences, as we have seen earlier. Radiological crime scene management helps in the handling of nuclear security incidents and also helps in catching and linking offenders to the scene. It can also help to link sites to other sites by analysing materials. However, it is not sufficient to deploy police crime scene investigators at such a scene because they lack experience in detecting, measuring and collecting radioactive materials and usually lack adequate radiological knowledge. At the same time, if only radiological experts are present at the site, the integrity of the scene and the chain of custody is damaged, i.e. it is not sustainable as evidence in court. If the traditional recording of evidences, digital data extraction and characterisation of radioactive/nuclear material can be done at the same time, possibly even on the scene, and the data obtained can be transmitted immediately and securely, I believe that the law enforcement potential will be significantly increased. This in the case of an attack of terrorism gives the authorities an extraordinary advantage.[20] If we can send video recordings in real time to the command post and send the photos via a data link as soon as the photo is taken, then through coordinated action, partner agencies, other experts, law enforcement agencies - even in other countries - can receive a live image via an encrypted channel in real time, thus assisting the team working in the investigation zone or sending the information to the appropriate agency.[21] The risks presented by CBRN threats are a permanent feature of today's world, and it is therefore justified to maintain and develop these detection capabilities.[22] So is the education and training of specialist staff. However, there is a gap in this area, as it is not included in the training of crime technicians. In my view, this must be corrected. Hungarian practical experience over the past 5 years shows that a mixed team is much more effective. In other words, the traditional police forensic team, complemented by radiology experts and working together on the ground, can work with very high efficiency. I would like to emphasise that by joint working I do not mean that the police forensic team works alone in the field on the basis of instructions from the radiology expert. This will not increase the efficiency of solving radiological problems that arise during the forensic investigation and the effectiveness of radiological issues and activities. An emergency cannot be managed well.
In my opinion, in order to implement an effective methodology, it is also important to coordinate our activities, because of the technician on the scene will not be the first to arrive. However, this also raises the issue of focusing on first responders and coordination with other organisations.

[19]Izabella, Kakuja Data extraction during CBRN crime scene investigation, Safety and Security Sciences Review, Vol 6, No 1, 2024. pp 82
[20]Izabella, Kakuja Data extraction during CBRN crime scene investigation, Safety and Security Sciences Review, Vol 6, No 1, 2024. pp 83
[21]Izabella Kakuja Unique Hungarian method in radiological crime scene management, Military Technology Volume LVI – 2022/5,
[22]László Juhász: Nuclear, biological and chemical (ABV) detection https://docplayer.hu/24496254-Az-atom-biologiai-es-vegyi-abv-felderites.html downloaded: 10.09.2023.

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